

## GOLF CLUB HEAD

## CROSS REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of  
5 priority from prior Japanese Patent Application No. 2003-415114,  
filed on December 12, 2003; the entire contents of which are  
incorporated herein by reference.

## BACKGROUND OF THE INVENTION

## 10 1. Field of the Invention

The present invention relates to a golf club head, and more specifically, relates to an iron-type golf club head composed of a metallic head body and a reinforced fiber member.

## 2. Description of the Related Art

15 In publicly-known conventional iron-type golf club heads each composed of a metallic head body and a reinforced fiber member, a metallic striking face part is formed to be thin-walled, and a thick-walled fiber reinforced plastic layer is attached to or filled in the back of the striking face part  
20 as shown in Japanese Patent publications No. 65708/1992 and No. 88153/1993 and Japanese Patent Laid-open publication No. 173513/1997.

25 Such golf club heads are considered to be capable of providing a larger launch angle and a longer carry of ball with their low center of gravity structure.

In the conventional golf club heads, a longer carry is intended to be realized by repulsive forces of the thin-walled metallic striking face part, which is deformed due to the impact applied thereto when the golf club head hits a golf ball, and  
30 the thick-walled fiber reinforced plastic layer to which the

deformation of the striking face part is directly transmitted.

However, the deformation of the metallic striking face part at the time of striking the ball is very small. This small deformation can produce a deformation, in the thickness 5 direction, of the fiber reinforced plastic layer therebehind, which produces a repulsive force against the ball. The repulsive force produced from the deformation of the layer alone is small, and the carry of the ball cannot be increased much.

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#### SUMMARY OF THE INVENTION

The present invention is made in the light of the above problem, and an object of the present invention is to provide a golf club head capable of providing a longer carry of a ball than ever before, by causing a larger repulsive force to act 15 on the ball, which force is produced using deformation of a metallic striking face part at the time when the golf club head strikes the ball.

To achieve the aforementioned object, the golf club head of the present invention includes: a metallic frame-shaped iron 20 head body including a heel section, a toe section, an upper edge section connecting the superior ends of the heel section and of the toe section, and a sole section; and a metallic thin-walled face section, having a high coefficient of restitution, provided on a front face of the head body. The 25 head body includes a rear wall section, spaced apart from the face section and extending upward from a rear end of the sole section. A reinforced fiber member is placed in an area surrounded by the face section, the sole section, and the rear wall section. The reinforced fiber member abuts on a back of 30 the face section to form a closed hollow void section. A part

of a back of the reinforced fiber member is supported on the rear wall section.

When the golf club head strikes a golf ball, the face section is deformed to bulge backward and to compress the closed void section of the reinforced fiber member therebehind. With the compression force, the closed void section is elastically deformed. Elastic restoring forces of the face plate and of the void section are combined to act on the golf ball as a repulsive force, thus increasing the carry of the golf ball.

Preferably, a part of the reinforced fiber member is shaped in a plate and brought in close contact with the back of the face section. The plate-shaped part of the reinforced fiber member and the other part thereof form an oblong sealed closed void section.

Also preferably, the rear wall section is formed of a chevron-shaped extension section protruding upward from the rear end of the sole section and a belt-shaped extension section diagonally connecting the top of the chevron-shaped extension section and the upper end of the toe section.

Hereinafter, a description is given of preferred embodiments of the present invention with reference to the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of an iron golf club head according to a preferred embodiment of the present invention.

FIG. 2 is a rear view of the iron golf club head shown in FIG. 1.

FIG. 3 is a sectional view taken along a line III-III of FIG. 2.

FIG. 4 is a rear view showing a second embodiment of the present invention.

FIG. 5 is a sectional view taken along a line V-V of FIG. 3.

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#### BEST MODES FOR CARRYING OUT THE INVENTION

Hereinafter, a description is given of preferred embodiments of the present invention with reference to the accompanying drawings.

10 FIGS. 1 to 3 show an iron golf club head according to a preferred embodiment of the present invention. In the front view of FIG. 1, a head body 10 of the club head is formed in a frame-shape composed of a hosel section 1, into which a shaft (not shown) is inserted, a heel section 2 under the hosel section 1, a circular arc-shaped toe section 3, a belt-shaped upper edge section 4 connecting the upper ends of the heel section 2 and of the toe section 3, and a sole 5 connecting the lower ends of the heel section 2 and of the toe section 3.

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As shown in FIGS. 2 and 3, on the back side of the head body 10, a chevron-shaped extension section 6 and a belt-shaped section 7 are provided. The chevron-shaped extension section 6 protrudes upward from the rear edge of the sole section 5 substantially at a right angle thereto. The belt-shaped extension section 7 connects the top of the chevron-shaped extension section 6 and the upper end of the toe section 3. In the rear view, in an area surrounded by both extension sections 6 and 7, heel section 2, and upper edge section 4 of the frame-shaped head body 10, a spindle-shaped gap section 8 is formed, which increases in diameter toward the heel section.

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In an area surrounded by both extension sections 6 and 7, and

toe section 3 of the frame-shaped head body 10, a substantially semicircular gap section 9 is formed.

Preferably, the frame-shaped head body 10 including the aforementioned chevron-shaped and belt-shaped extension 5 sections 6 and 7 are molded from stainless steel.

To the front opening of the frame-shaped head body 10, the peripheral edge part of a face plate 11 is integrally fixed by press fitting, welding, adhesion, or the like. Preferably, the face plate 11 is formed of a titanium alloy with a high 10 coefficient of restitution. The face plate 11 is 3 to 4 mm thick in the peripheral edge part and 1.0 to 2.5 mm thick in the striking face part except for the peripheral edge part. To the back of the striking face part of the face plate 11, a fiber reinforced resin plate 12, composed of reinforced fibers of 15 carbon or the like, is integrally bonded. Preferably, the thickness of the fiber reinforced resin plate 12 is larger than that of the striking face part. The face plate 11 includes a number of lateral grooves with predetermined width and depth in the striking face part as publicly known.

20 In the present invention, as shown in FIG. 3, a sheet-shaped fiber reinforced plastic (FRP) member 13 covers an inner surface of the sole section 5 of the frame-shaped head body 10 and stands substantially at a right angle on the rear end of the sole section 5 to extend entirely across the heel 25 section 2, the toe section 3, and the upper edge section 4 of the frame-shaped head body 10. Peripheral edge part of the fiber reinforced plastic member 13 is tightly joined to the peripheral edge part of the fiber reinforced resin plate 12, which is attached to the back of the face plate 11. Accordingly, 30 a sealed hollow void section 14 is formed between the fiber

reinforced plastic member 13 and the fiber reinforced resin plate 12, which is bonded to the back of the face plate 11. The void section 14 has a substantially triangular shape section as shown in FIG. 3, when vertically cut in a front to rear 5 direction at the center of the head body. Part of the outer back of the fiber reinforced plastic member 13, where the chevron-shaped and belt-shaped extension sections 6 and 7 are located, is joined to inner surfaces of the extension sections 6 and 7.

10 In the lower back of the chevron-shaped extension section 6, a triangular recess is formed, and a weight plate 15 composed of a tungsten plate is buried in the recess.

15 Since the iron golf club head of the present invention is structured as described above, when the face plate 11 strikes a golf ball, the impact thereof causes the face plate 11 to bulge backward in the center part except the peripheral edge part supported by the frame-shaped head body 10. The deformation 20 of the face plate 11, the back of which is integrally bonded to the fiber reinforced resin plate 12 except the peripheral edge part, is comparatively large. The face plate 11 bulging backward applies a force to compress the closed void section 14, which is formed between the face plate 11 and the fiber reinforced plastic member 13 therebehind. With this compression force, part of the fiber reinforced plastic member 13 which is 25 not in contact with the head body 10, specifically, portions of the back of the fiber reinforced plastic member 13 corresponding to the spindle-shaped gap section 8 and to the semicircular gap section 9, where the chevron-shaped and belt-shaped extension sections 6 and 7 are not located, are 30 microscopically deformed to swell outward.

The elastic restoring force of the face plate 11 generated by such deformation and the elastic restoring force of the fiber reinforced plastic member 13 deformed to swell outward are combined to act on the golf ball as a repulsive force. The carry 5 of the golf ball thus provided can be therefore larger than the carry provided by the conventional golf club head using only elastic deformation of the face plate.

Next, a test for comparison was carried out using a golf swing robot, with the golf club head of the present invention 10 according to the above embodiment and golf club heads of Comparative Examples 1 and 2. The golf club head of Comparative Example 1, was made solid by filling a carbon fiber reinforced resin member between the aforementioned face plate 11, and the chevron-shaped and belt-shaped extension sections 6 and 7. The 15 golf club head of Comparative Example 2 was the same as the golf club head of the above embodiment except that the fiber reinforced plastic member 13 is removed. In each of the golf club heads of the present invention and Comparative Examples 1 and 2, the striking face part of the face plate was composed 20 of a titanium face of 1.5 mm thickness and of a carbon fiber reinforced resin plate of 2 mm thickness bonded to the back of the titanium face. The length of a club was 38.0 inches, and the loft was 25 degrees. Properties regarding head center of gravity and the coefficients of restitution of these golf club 25 heads were measured as shown in Table 1.

Table 1

Golf Club Name	Head Center of Gravity Properties			Coefficient of Restitution
	Center of Gravity Height (mm)	Center of Gravity Depth (mm)	Center of Gravity Distance (mm)	
Present Invention	19.6	5.7	41.5	0.774
Comparative Example 1	19.9	5.3	41.5	0.765
Comparative Example 2	20.8	5.0	39.3	0.746

As apparent from Table 1, the golf club head of the present invention had a lower center of gravity and a higher coefficient of restitution than those of the golf club heads of Comparative Examples 1 and 2.

Next, results of the test using the robot are shown in Table 2.

Table 2

Golf Club Name	Robot Test Result				
	Head Speed (m/s)	Carry (Yard)	Initial Speed (m/s)	Launch Angle (°)	Spin Rate (rpm)
Present Invention	33.0	150.8	44.5	18.7	3166
Comparative Example 1	33.0	148.0	44.0	18.4	3567
Comparative Example 2	33.0	144.3	42.7	17.2	3889

As apparent from Table 2, the launch angle of the golf club head according to the present invention was larger than those of Comparative examples 1 and 2, and the carry of the golf club head according to the present invention was much larger  
5 than those of Comparative Examples 1 and 2.

FIGS. 4 and 5 show an iron golf club head according to  
a second embodiment of the present invention. The following  
description is given of differences of the golf club head of  
this embodiment from the golf club head of the first embodiment.  
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In this golf club head, the sole section 5 is formed so  
that the rear part thereof is approximately twice thicker than  
the front part thereof. A rear center part 16 of the sole  
section 5 is substantially chevron-shaped and is swelled out  
as shown in FIG. 4. To an upper rear end of the sole section  
15 5, a first metallic plate material 17 is attached so as to extend  
upward. A triangular second metallic plate material 18 is  
attached to a lower surface of the belt-shaped upper edge  
section 4, which connects the upper ends of the heel section  
2 and of the toe section 3, so as to be pendent downward. A  
20 substantially V-shaped gap section is thus demarcated between  
the plates 17 and 18.

In this embodiment, a thick sheet-shaped fiber reinforced  
resin layer 19a is placed in close contact with the back of the  
face plate 11, and another sheet-shaped fiber reinforced resin  
25 layer 19b of a medium-thickness, which is thinner than the fiber  
resin layer 19a, is placed in close contact with inner surfaces  
of the first metallic plate 17 and of the second metallic plate  
18. A thin fiber reinforced resin layer 19c is integrally  
joined to the peripheral edges of the fiber reinforced resin  
30 layers 19a and 19b, thus forming a closed hollow void section

14a.

In this embodiment, the peripheral part which demarcates the hollow void section 14a is formed to be thin. Accordingly, when the face plate 11 strikes a golf ball and bulges backward, 5 the hollow void section 14a is easily deformed. The void section 14a is therefore greatly deformed, thus producing a larger elastic restoring force.

The present invention is not limited to the aforementioned embodiments. For example, the reinforced fibers 10 can be glass fibers, aramid fibers and the like, in addition to carbon fibers.

#### INDUSTRIAL APPLICABILITY

As described above, with the golf club head of the present 15 invention, when the golf club head strikes a golf ball, the face section thereof is deformed to bulge backward and to compress the closed void section therebehind. The elastic restoring forces of the face plate and the compressed void section are combined to act on the golf ball as a repulsive force, thus 20 increasing the carry of the golf ball.